Electronic Journal of Applied Statistical Analysis
EJASA, Electron. J. App. Stat. Anal.
http://siba-ese.unisalento.it/index.php/ejasa/index
e-ISSN: 2070-5948
DOI: 10.1285/i20705948v10n3p735

Is there a bye week advantage in college football?
By Howington, Moates

Published: 15 November 2017

Electronic Journal of Applied Statistical Analysis
Vol. 10, Issue 03, November 2017, 735-744
DOI: 10.1285/i20705948v10n3p735

Is there a bye week advantage in college football?

Eric B. Howington*and K. Nathan Moates

Valdosta State University, Langdale College of Business
1500 N. Patterson St., Valdosta, GA 31698-0075, USA

Published: 15 November 2017

During the 2010 college football season, the University of Alabama football team faced six consecutive Southeastern Conference (SEC) opponents who had byes, a week off from competition, before their match-up with Alabama. Journalists speculated that these opponents would have an advantage due to the extra time for preparation, rest and recovery. After the season, the SEC responded by passing a new rule limiting teams to three conference opponents coming off bye weeks. Was this rule change necessary? If there is a bye week advantage, what is its estimated magnitude? This paper presents an exploratory analysis of data from the 2010 college football season. A linear model is used to estimate ratings of team strength for each FBS (Football Bowl Subdivision) college football team as well as the magnitude of the home field advantage. The model is modified to estimate the magnitude of the bye week advantage under several scenarios. All of the scenarios considered agree that the bye week advantage is actually a "myth."

keywords: college football, rating team strength, home field advantage

1 Introduction

Many US colleges and universities field American football teams. Each fall, over 750 football games are played by college teams in the Football Bowl Subdivision (FBS) of the NCAA (National Collegiate Athletic Association). These games are tremendously popular and widely televised. They generate tremendous amounts of revenue and inspire countless hours of debate and conversation among college football fans around the world.

*Corresponding author: ebhowington@valdosta.edu

ISSN: 2070-5948
http://siba-ese.unisalento.it/index.php/ejasa/index

Each season brings new story lines to the forefront of the media. In 2010, one story line that generated significant discussion was the issue of bye weeks. The University of Alabama football team faced six opponents who had byes the week before playing Alabama. Many commentators claimed this would be a significant disadvantage to the Alabama football team as they attempted to repeat as BCS (Bowl Championship Series) champions. The Alabama football team finished with a win-loss record of 10-3 overall, and 3-3 in the six games against opponents who had byes the week before playing Alabama.

Popular wisdom suggests that having a bye week provides two specific advantages to the team that has the extra time off: more preparation time for the next opponent and extra time to rest and recover from the previous game for the players.

In a *Wall Street Journal* article entitled "The Myth of the Bye-Week Advantage," columnist Darren Everson compiled data for the win-loss results for all BCS conference games involving teams coming off bye weeks from 2002 to 2010. The data do not indicate an advantage for the team that is coming off the bye week. Overall, teams coming off bye weeks won 48% of the time (Everson, 2010).

While this result suggests that there is no bye week advantage, it does not consider important factors like home field advantage or the relative strength of the teams that are playing each other.

If it is true that bye weeks do have a significant impact on the outcomes of college football games, then it might impact the way football programs schedule their opponents. In fact, the SEC passed a rule that no SEC team has to play more than three league opponents coming off a bye week in a single season. This new bye week rule took effect starting with the 2011 college football season.

This research attempts to estimate the magnitude, in terms of points in favor of the team coming off the bye week, of the bye week advantage. The linear model ranking system described by Harville (1977) and Harville (2003), which generates estimates of team effects and the home field advantage, will be modified to estimate the direction and magnitude of the bye week advantage under several different scenarios.

2 Data for the 2010 College Football Season

Data for each NCAA football game involving FBS subdivision schools during the 2010 college football season was obtained from James Howell's college football scores archive (Howell, 2010). Data for each game includes the teams involved in the game, the final score for each team, the designated home team, and, for games played at neutral sites, the location of the game.

During the 2010 college football season, there were 120 college football teams within the FBS division. A number of games pitted FBS teams against teams from a smaller division, the FCS (Football Championship Subdivision). FCS teams are, generally, not as strong as FBS teams. To simplify the analysis, these cross division games were eliminated from the data set. In college football, post-season play can be delayed by as much as a month or more and is often considered a separate entity. The authors chose

to exclude post-season play in this analysis. This left data for 683 regular season games between FBS teams.

In these 683 games, points scored by each team ranged from 0 to 83 points, with an average of 27.2 points per game. A new variable, the score difference, defined as home team score minus visiting team score, was created and added to the data. The score differences ranged from −68 to +72. The distribution of the score differences is roughly symmetric and bell shaped, as illustrated in Figure 1.

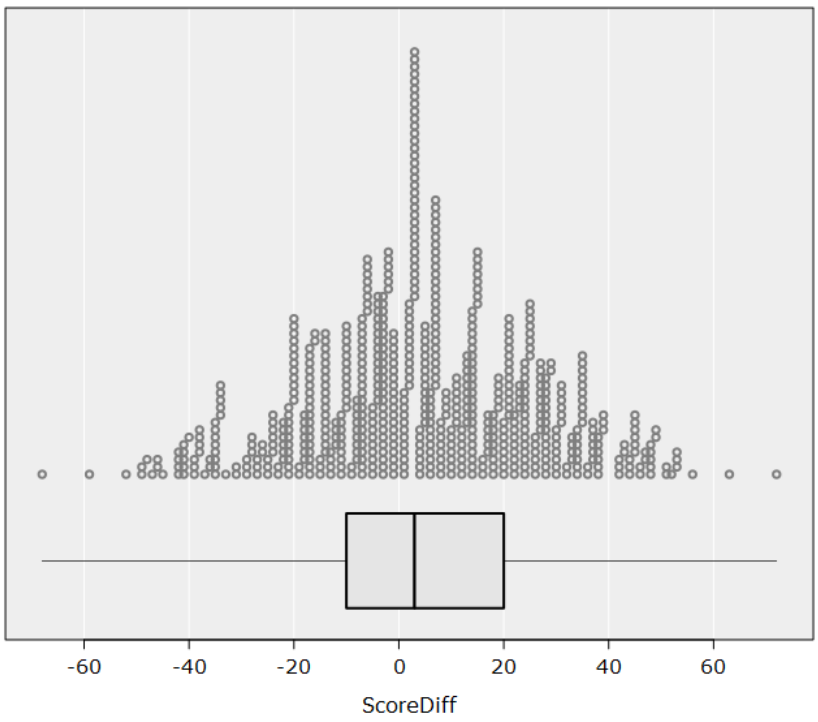

Figure 1: The distribution of score differences

3 Modeling Team Strength, Home Field Advantage and Bye Week Advantage

There are a number of ways that college football teams can be rated (Stefani and Pollard, 2007). Harville (1977) and Harville (2003) suggests using a linear model to calculate ratings of team strength and the home field advantage. This methodology can be readily modified to allow for estimating the bye week advantage.

3.1 The Basic Model

Let y_{ijk} be the difference in the scores of the ith team (the home team) and jth team (the visiting team) in the kth game played between these teams (the score difference variable defined above). Note that in college football, k will be 1 or 0 as teams play each other either once or zero times during the regular season. Let x_{ijk} be an indicator variable that equals 0 if the game is played at a neutral site and +1 if the game is played at the home team's field. Consider the model

$$y_{ijk} = x_{ijk} \cdot \mu + \beta_i - \beta_j + e_{ijk} \tag{1}$$

where μ is the home field advantage and the β's are the team effects (ratings of team strength). The β's and μ are unknown parameters and the e_{ijk}'s are random residuals effects with mean 0 and unknown variance σ^2. Note that this model assumes that the home-field advantage, μ, is constant across all teams. In rating schemes such as this, it is common to assume the e_{ijk}'s are independent and normally distributed. Since a football game is made up of successive, more-or-less independent pairs of alternating opportunities to score, and the final score difference is the sum of the differences in score from these opportunities, the assumption is reasonable. Note that the score differences are actually integer values. Nevertheless, the model gives reasonable results in practice.

To estimate the β's, participation indicator variables must be created. For each of the 120 FBS teams, a participation indicator variable associated with each game is created. The participation indicator takes the value +1 if the team participates in the game as the home team, −1 if the team participates as the visiting team, or 0 if the team does not participate in the game. The model specified above is a non-full rank model, but this can be overcome by adding a constraint – one team is constrained to a strength rating of 0. With this added constraint, the model is fit by the method of least squares using the common statistical software R (R Core Team, 2015).

This simple model is interesting in that it provides a single, overall rating of team strength for each team. These ratings can then be sorted and the sorted ratings used to rank the teams from strongest to weakest. The model also provides an estimate of the magnitude of the home field advantage.

Applying the model to our modified data (no FCS, no post-season games) from the 2010 college football season, the estimated home field advantage is 2.60 points. This is consistent with the 2.0-4.0 point range typically attributed to the home field advantage in recent (1980-present) college football seasons (Gill and Keating, 2009). Table 1 displays the highest fifteen ratings of team strength. The third column gives the AP (Associated Press) rank of each of these teams at the end of the regular season, prior to Bowl games. Note that the team strength ratings have been scaled, by adding a constant, so that the weakest team has a rating of 0.0.

The model does not give the exact rankings of the week 15 AP poll, but that is not unexpected. While college football fans would argue over the exact ordering of these teams, the results do show that the model identifies the top teams with reasonable accuracy. Michigan State (AP rank 7), Louisiana State (11), Nevada (13), and Missouri (14) were in the AP top 15 at the end of the regular season, but did not make the

Table 1: Top 15 Teams by Team Strength Rating

Team	Strength Rating	Week 15 AP Rank	Wins-Losses
Oregon	67.9	2	12-0
Stanford	64.4	5	11-1
Boise State	63.1	10	11-1
Texas Christian	58.2	3	12-0
Alabama	56.7	15	9-3
Auburn	56.6	1	13-0
Ohio State	55.3	6	11-1
Virginia Tech	52.6	12	11-2
Oklahoma	52.0	9	11-2
Arkansas	51.2	8	10-2
Wisconsin	50.8	4	11-1
Oklahoma State	50.0	16	10-2
Nebraska	50.0	17	10-3
South Carolina	49.9	19	9-4
Arizona State	49.8	unranked	6-6
Home Field Advantage	2.60		

top 15 of the team strength ratings. They are replaced by Oklahoma State (AP rank 16), Nebraska (17), South Carolina (19), and Arizona State (unranked by AP). The top teams identified by the model are, for the most part, the same top teams identified by the journalists voting in the AP poll.

3.2 Modeling the Bye Week Advantage

Modify the linear model described in the previous section by adding another term for the bye week advantage. The new model is

$$y_{ijk} = x_{ijk} \cdot \mu + \beta_i - \beta_j + z_{ijk} \cdot \tau + e_{ijk} \tag{2}$$

where z_{ijk} takes the value $+1$ if only the home team was off the previous week, -1 if only the visiting team was off the previous week, or 0 if neither or both teams were off the previous week. If both teams had byes, any advantage is assumed to be nullified for both teams. This model assumes that the off-weak advantage, τ, is constant across all teams.

3.3 Scheduling Issues

Another issue that must be addressed is what is considered to be a bye week? If all college football games were played only on Saturdays, then a bye week would give a team an advantage of 7 days of preparation time and rest over the opposing team that was not off the previous Saturday. However, due to extensive television coverage of college football games, games may be played virtually any day of the week. It is common for teams to have different amounts of time off between games. For example, Thursday night games could result in short weeks of less than 7 days to prepare, or long weeks of more than 7 days to prepare, but less than the 14 days of a traditional bye week. How many additional days off constitutes a bye week advantage over your opponent? Is one extra day of rest and preparation a significant advantage? Are three additional days advantageous? This is a subjective consideration. In this paper, two cases are examined. In the first case, a team with an advantage of 3+ days off is considered to benefit from a potential bye week advantage. In the second case, the advantage in days off must be 6 or more.

3.4 Late-Season

What if bye weeks have a different effect when they occur later in the season? Football is a physically demanding sport and it makes sense that a late season bye week may be beneficial to team performance. Early in the season, players are likely to be healthier and fresher than late in the season. Over the first weeks of the season, players will accumulate bumps, bruises, and minor injuries. A late season bye week gives a chance to recover from minor health issues. We will consider the model over the whole season and then reconsider the model over only the last eight weeks of the season.

4 Results

The results of applying the model from section 3.2 to the scenarios described in sections 3.3 and 3.4 are discussed below.

4.1 Case A

In this case, the model is evaluated over the entire season and a team is subjected to the bye week advantage if they have an advantage in preparation of 3 or more days over their opponent. The top 5 teams and their strength ratings based this model are displayed in Table 2. The top 5 changes slightly from that in Table 1 – Alabama drops out, and TCU and Auburn move up one spot each. The estimate of the home field advantage is again 2.60 points. Interestingly, the off-week advantage is estimated at -0.90 points, which is not an advantage at all.

4.2 Case B

In this case, the model is evaluated over the entire season and a team is subjected to the bye week advantage if they have an advantage in preparation of 6 or more days over their

Table 2: Bye Week Advantage, Case A: 3 or more days off

Team	Strength Rating	Week 15 AP Rank	Wins-Losses
Oregon	67.7	2	12-0
Stanford	64.3	5	11-1
Boise State	62.7	10	11-1
Texas Christian	57.9	3	12-0
Auburn	56.8	1	13-0
Home Field Advantage	2.60		
Off Week Advantage	−0.90		

opponent. The top 5 teams and their strength ratings based this model are displayed in Table 3. The order of the teams is unchanged from case A. The estimate of the home field advantage is 2.59 points. In this case, the bye week advantage is estimated at −0.27 points, a slight disadvantage.

Table 3: Bye Week Advantage, Case B: 6 or more days off

Team	Strength Rating	Week 15 AP Rank	Wins-Losses
Oregon	67.8	2	12-0
Stanford	64.3	5	11-1
Boise State	62.7	10	11-1
Texas Christian	58.0	3	12-0
Auburn	56.8	1	13-0
Home Field Advantage	2.59		
Off Week Advantage	−0.27		

4.3 Case C

Case C defines the bye week advantage as in case A, a 3+ day advantage in preparation time, but the bye week advantage is only considered over the last eight weeks of the season. The results for the top 5, home field advantage, and bye week advantage are given in Table 4. Home field advantage is 2.61 points. The estimated bye week advantage is increased in magnitude to −2.42 points. Again, it appears that the bye week advantage is actually a disadvantage.

Table 4: Bye Week Advantage, Case C: 3 or more days off, late season only

Team	Strength Rating	Week 15 AP Rank	Wins-Losses
Oregon	67.8	2	12-0
Stanford	64.3	5	11-1
Boise State	62.4	10	11-1
Texas Christian	57.8	3	12-0
Auburn	56.8	1	13-0
Home Field Advantage	2.61		
Off Week Advantage	−2.42		

4.4 Case D

Case D defines the bye week advantage as in case B, an advantage in preparation time of 6 or more days, but the bye week advantage is only considered over the last eight weeks of the season. The results for the top 5, home field advantage, and bye week advantage are given in Table 5. Bye week advantage (disadvantage) is estimated at −3.53 points. Home field advantage is 2.60 points in this model. The bye week disadvantage is larger in magnitude than the home field advantage for case D.

Table 5: Bye Week Advantage, Case D: 6 or more days off, late season only

Team	Strength Rating	Week 15 AP Rank	Wins-Losses
Oregon	67.5	2	12-0
Stanford	64.3	5	11-1
Boise State	62.0	10	11-1
Texas Christian	57.7	3	12-0
Auburn	56.5	1	13-0
Home Field Advantage	2.60		
Off Week Advantage	−3.53		

5 Conclusions

Table 6 summarizes the results of the analyses.

Table 6: Summary of Model Estimates

Model	Home Field Advantage	Off Week Advantage
Base model	2.60	NA
Case A (3+ days)	2.60	−0.90
Case B (6+ days)	2.59	−0.27
Case C (3+ days, late season)	2.61	−2.42
Case D (6+ days, late season)	2.60	−3.53

It appears Darren Everson was correct when he called the bye week advantage a "myth."While it seems to contradict common sense notions regarding the advantages of extra preparation and recovery time for teams coming off bye weeks, the above analyses do not support any benefit at all, much less a significant one. In fact, it appears that the bye week advantage is actually a disadvantage that negatively affects the outcome of the game for the team that is coming off a bye week. Even more interestingly, the disadvantage appears to be magnified over the last half of the season. This is particularly noteworthy, given that the assumed advantage associated with additional time to recover from nagging injuries and/or expand game preparation (such as film study) would seem most needed in the latter weeks of the season.

There are several possible explanations for these results. First, it is possible that weaker teams are scheduling bye weeks before games with opponents who are expected to field stronger teams. In other words, scheduling bye weeks prior to "top tier"competition may create an illusory "disadvantage"that is really just a result of facing a more challenging opponent. The scheduling practices of Alabama's 2010 opponents (six of them scheduled their bye week before their game against the defending champions), would certainly suggest that perceived opponent quality is a strong scheduling factor. In fact, an interesting future research question would be to examine the relationship between some measure of opponent strength (such as previous year ranking) and post bye week scheduling.

Another possibility is that coaches are saving "special"plays or strategies to off-set the advantage gained by the team with the bye week. For instance, a coaching staff might prepare for an opponent with the opponent's "extra time off"figuring heavily in the development of more opponent-specific strategies, in an effort to counteract any perceived bye week advantage. Ironically, these efforts may create the bye week disadvantage suggested by the above results.

It is also possible that players get "rusty"during the bye week and do not perform as well in games following elongated breaks. Interestingly, the psychological concept of "flow"could be applied to provide some rationale for this possible explanation. Flow (commonly referred to as "being in the zone") is the mental state of complete focus and

immersion experienced by individuals performing a familiar task. Though the concept has typically been used to describe individual states, researchers have also begun to explore the possibility of group or team level flow (van den Hout et al., 2016). While the time frames investigated in such studies are typically over a period of hours, rather than weeks, it is not unreasonable to theorize that any group activity with a regular rhythm (such as a weekly athletic schedule) might develop a "macro-flow"of its own. Thus, any interruption in habituated patterns, especially toward the end of the season, when such patterns would be most engrained, might disrupt the group flow of a team. The interruption of flow in this scenario might provide a psychological explanation for the seemingly counter intuitive negative impact of bye weeks on subsequent performance.

Finally, it is possible that these results are unique to the 2010 NCAA FBS season data. Future investigations could use data from different seasons, or even other leagues of play (such as the National Football League), to assess the generalizability of the findings. For now, however, we can question the generally held belief that time off is necessarily time well spent.

Acknowledgement

This research was supported by a Langdale College Rea and Lillian Steel Summer Grant.

References

Everson, D. (2010). The myth of the bye week advantage. *The Wall Street Journal*. http://online.wsj.com/article/SB10001424052748703673604575550133637891028.html.

Gill, R. and Keating, J. (2009). Assessing methods for college football rankings. *Journal of Quantitative Analysis in Sports*, 5(2).

Harville, D. (1977). The use of linear-model methodology to rate high school or college football teams. *Journal of the American Statistical Association*, 72(358):278–289.

Harville, D. A. (2003). The selection or seeding of college basketball or football teams for postseason competition. *Journal of the American Statistical Association*, 98(461):17–27.

Howell, J. (2010). James howells college football scores. Retrieved from http://homepages.cae.wisc.edu/ dwilson/rsfc/history/howell/.

R Core Team (2015). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Stefani, R. and Pollard, R. (2007). Football rating systems for top-level competition: A critical survey. *Journal of Quantitative Analysis in Sports*, 3(3).

van den Hout, J., Davis, O., and Walrave, B. (2016). The application of team flow theory. In Harmat, L., Orsted Andersen, F., Ulln, F., Wright, J., and Sadlo, G., editors, *Flow Experience: Empirical Research and Applications*, chapter 15, pages 233–247. Springer.